

ABSTRACT

Permeability is one of the most important factors in influencing the commercial viability of a hydrocarbon reservoir. So far, permeability cannot be measured directly in-situ in reservoir formations. This invention relates to the field of estimating in-situ permeability of the reservoir rock formations. The measurements can be made across two wells or in a single well. Due to the morphology of their pore interconnections and the pore fluids in the rock, permeable rocks are elastically nonlinear. In a permeable rock, which is elastically nonlinear, the interactions between two elastic waves can be used in a unique way to map its physical properties. In this invention, the interaction of an elastic wave generated within the permeable rock with an externally generated seismic signal is used to determine the bulk tortuosity and bulk permeability of a reservoir rock formation.

References cited:

Johnson, P.A., Rasolofosaon, P.N.J.; Manifestation of Nonlinear Elasticity in Rock:
Convincing Evidence Over Large Frequency and Strain Intervals from Laboratory
5 Studies;

Journal: Nonlinear Processes in Geophysics.

Johnson, P.A., Shankland, T.J.; Nonlinear Generation of Elastic Waves in Crystalline
Rock;

10 Journal: Journal of Geophysical Research.

Meegan, G.D., Johnson, P.A.; Observation of Nonlinear Elastic Wave Behaviour in
Sandstone;

Journal: Journal Acoustic Society of America.

15 Biot, M. A., 1956, Theory of propagation of elastic waves in a fluid saturated porous
solid:

Journal Acoustic Society of America.

20 Scheidegger, A. E. 1960, Physics of flow through porous media:
University of Toronto.

Klimentos, T., McCann, C., 1988, Why is the Biot Slow Compressional Wave not
observed in real rocks.

25 Geophysics 53, 1605.

Johnson, P.A., McCall, K.R.; Observations and Implications of Nonlinear Elastic
Wave Response in Rock;

Journal: Geophysical Research letters.

30

U.S. Patent Document

845987

Jan. 2001

Khan

367/32.